

# **AIRS/AMSU/HSB Version 4.0 Level 2 QA Quick Start**

**Version 1.0**

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## Introduction

All AIRS Data Products are released, even those which are not as yet validated or are considered substandard. In the V3.0 data release, users were advised that the best practice for selecting data products to be included in scientific analyses is to require the fields-of-view to pass the **RetQAFlag = 0** filter. This “all or nothing” option is still available to the casual user of AIRS Data Products in the V4.0 data release and allows selection of the highest quality retrievals in the AIRS Level 2 Data Products. If you fit in this category, you can forego reading further and simply refer to the single page document:

### V4.0\_RetQAFlag.pdf

V4.0 introduces a set of product-specific quality flags that can be used to select valid Level 2 geophysical data products that would otherwise be filtered out by the use of the **RetQAFlag** test. This document provides a quick start identification of the quality flags that may be used to choose data for analysis.

The AIRS retrieval system provides three Level 2 products:

- L2 Standard Product
- L2 Support Product
- L2 Cloud-Cleared Radiance Product

Users are encouraged to use the Standard Product and Cloud-Cleared Radiance Product in their research.

The Support Product is intended for the knowledgeable, experienced user of AIRS products. It contains high resolution profiles intended to be used for computation of radiances, as-yet unimplemented research products and various parameters and intermediate results used to evaluate and track the progress of the retrieval algorithm. In particular, partial retrievals may fill support product fields with values that at first glance appear to be physically meaningful. However, these quantities are often intermediate results from various stages of the retrieval algorithm, are not physically meaningful and are used by the developers to improve algorithm performance for future deliveries.

In all products, the user must ignore fields that are filled with the invalid values:

- -9999 for floating-point numbers and 16-bit and 32-bit integers
- -1 or 255 for 8-bit fields

Please note that the field, **retrieval\_type**, should not be used to select data for research. That field now indicates which path was taken through the retrieval algorithm and does not necessarily indicate the quality of the retrieval. A zero value simply indicates that the infrared radiances were employed.

## RetQAFlag

The main quality indicator for all Level 2 products is the swath data field, **RetQAFlag**, which is present in all Level 2 Product Files. The casual user can create a subset of FOVs for analysis by selecting only those in which **RetQAFlag** = 0 (i.e., all bits of this 16-bit integer are set to zero). FOVs passing this test will be the highest quality retrievals and within the class of record type which have been validated.

The following table defines the bits of **RetQAFlag**. Definition of bits 0 – 4 remains identical to V3.0; definition of higher bits is changed or new in V4.0.

Bit 15	Spare, set to zero
Bit 14	Ozone retrieval rejected ( <b>Qual_Ozone</b> > 0) or not attempted.
Bit 13	Water vapor retrieval rejected ( <b>Qual_H2O</b> > 0) or not attempted.
Bit 12	Top part of temperature profile quality check failed ( <b>Qual_Temp_Profile_Top</b> > 0) or not attempted. (above <b>Press_mid_top_bndry</b> mbar, indices <b>nStd_mid_top_bndry</b> and <b>nSup_mid_top_bndry</b> ; see <b>Qual_Temp_Profile_Top</b> for details)
Bit 11	Middle part of temperature profile quality check failed ( <b>Qual_Temp_Profile_Mid</b> > 0) or not attempted. (between <b>Press_bot_mid_bndry</b> and <b>Press_top_mid_bndry</b> mbar, indices <b>nStd_bot_mid_bndry</b> , <b>nSup_bot_mid_bndry</b> , <b>nStd_bot_mid_bndry</b> , and <b>nSup_bot_mid_bndry</b> ; See <b>Qual_Temp_Profile_Mid</b> for details)
Bit 10	Bottom part of temperature profile quality check failed ( <b>Qual_Temp_Profile_Bot</b> > 0) or not attempted. (below <b>Press_bot_mid_bndry</b> mbar, indices <b>nStd_bot_mid_bndry</b> and <b>nSup_bot_mid_bndry</b> ; <b>Qual_Temp_Profile_Bot</b> for details)
Bit 9	Surface retrieval is suspect ( <b>Qual_Surf</b> > 0) or rejected.
Bit 8	This record type not yet validated
Bits 6-7	Spare, set to zero
Bit 5	Cloud/OLR retrieval rejected or not attempted
Bit 4	Final retrieval rejected or not attempted
Bit 3	Final Cloud Clearing rejected or not attempted
Bit 2	Initial Regression rejected or not attempted
Bit 1	Initial Cloud Clearing rejected or not attempted;
Bit 0	MW retrieval rejected or not attempted

**Table 1. RetQAFlag with new bits defined**

## New Quality Control Flags for Retrieved Geophysical Quantities

In this release, a set of quality flags, **Qual\_\***, has been provided to inform the user separately about the quality of the retrieval of various products, and the retrieved temperature in three altitude regimes. The user who carefully employs these flags will substantially increase the sample size of various retrieved parameters.

<b>Qual_MW_Only_Temp_Strat</b>	Overall quality flag for MW-Only temperature fields for altitudes above 201 mbar
<b>Qual_MW_Only_Temp_Tropo</b>	Overall quality flag for MW-Only temperature fields for altitudes at and below 201 mbar, including surface temperature.
<b>Qual_MW_Only_H2O</b>	Overall quality flag for MW-Only water (both vapor and liquid) fields. The possible values this flag are <b>0</b> (H2O retrieval fully valid), <b>1</b> (only total precipitable water vapor is valid), <b>2</b> (H2O invalid)
<b>Qual_Cloud_OLR</b>	Overall quality flag for cloud parameters and clear and cloudy OLR
<b>Qual_H2O</b>	Overall quality flag for water vapor fields
<b>Qual_CO</b>	Quality flag for CO
<b>Qual_O3</b>	Quality flag for ozone
<b>Qual_Temp_Profile_Top</b>	Quality flag for temperature profile at and above <b>Press_mid_top_bndry</b> mbar (currently 200 mb)
<b>Qual_Temp_Profile_Mid</b>	Quality flag for temperature profile between <b>Press_mid_top_bndry</b> mbar and <b>Press_bot_mid_bndry</b> mbar (currently 3 km above surface)
<b>Qual_Temp_Profile_Bot</b>	Quality flag for temperature profile below <b>Press_bot_mid_bndry</b> mbar, including surface air temperature
<b>Qual_Surf</b>	Overall quality flag for surface fields including surface temperature, emissivity, and reflectivity
<b>Qual_CC_Rad</b>	Overall quality flag for cloud cleared radiances
<b>Qual_Guess_PSurf</b>	Quality flag for surface surface pressure guess input. The possible values are <b>0</b> (good surface pressure guess from valid forecast), <b>1</b> (surface pressure guess estimated from topography), and <b>2</b> (do not use)

**Table 2. New Quality Control Flags for Retrieved Geophysical Quantities**

## ***Discussion of Quality Flags for Level 2 Physical Products***

The possible values of the above flags are 0, 1 and 2.

- 0 indicates that the corresponding retrieved parameters are of best quality and can be used in validation statistics as well as level 3 processing.
- 1 indicates that the corresponding retrieved parameters are of good quality to be used in level 3 processing but not in validation statistics.
- 2 indicates that the corresponding retrieved parameters are of poor quality and hence should not be used in subsequent data analysis.

Some of the flags are not given the value of 1 in this version.

### **Qual\_Guess\_PSurf**

Quality flag for surface pressure guess input.

- 0 signifies good surface pressure guess from valid forecast
- 1 signifies surface pressure guess estimated from topography
- 2 signifies that it should not be used

This quality flag is practically always 0. It will assume a value of 1 only if the retrieval was run without the NCEP forecast input.

### **Qual\_MW\_Only\_Temp\_Strat**

Overall quality flag for MW-only temperature fields above 201 mb

This quality flag is 0 for approximately 95% of all retrievals.

### **Qual\_MW\_Only\_Temp\_Tropo**

Overall quality flag for MW-only temperature fields below 201 mb, including surface temperature.

This quality flag is 0 for approximately 94% of all retrievals

### **Qual\_MW\_Only\_H2O**

Overall quality flag for MW-only water (both vapor and liquid).

- 0 signifies H2O retrievals fully valid (86% of retrievals in Collection 4, i.e., if HSB data are included)
- 1 signifies only total precipitable water vapor is valid (0% of retrievals in Collection 4, i.e., if HSB data are included)
- 2 signifies H2O retrievals invalid (14% of retrievals in Collection 4, i.e., if HSB data are included)

In Collection 3 (no HSB data available), this flag assumes values of 1 (mostly over water) or 2.

### **Qual\_H2O**

Overall quality flag for water vapor fields

- 0 signifies water vapor retrievals valid (87% of retrievals over water; 83% of retrievals over land)
- 1 never occurs
- 2 signifies water vapor retrievals invalid

### **Qual\_CO**

Overall quality flag for CO research product. Not implemented in V4.0

### **Qual\_Ozone**

Overall quality flag for ozone fields

- 0 signifies ozone retrievals valid (87% of retrievals over water; 83% of retrievals over land)
- 1 never occurs
- 2 signifies ozone retrievals invalid

### **Qual\_Temp\_Profile\_Top**

Quality flag for temperature profile at and above Press\_mid\_top\_bndry (200 mb)

- 0 signifies temperature profile in this pressure regime valid (88% of retrievals over water; 86% of retrievals over land)
- 1 never occurs
- 2 signifies temperature profile in this pressure regime invalid

### **Qual\_Temp\_Profile\_Mid**

Quality flag for temperature profile between Press\_mid\_top\_bndry (200 mb) and Press\_bot\_mid\_bndry (3 km above surface)

0 signifies temperature profile in this pressure regime valid (58% of retrievals over water; 68% of retrievals over land)

1 never occurs

2 signifies temperature profile in this pressure regime invalid

### **Qual\_Temp\_Profile\_Bot**

Quality flag for temperature profile below Press\_mid\_top\_bndry (3 km above surface)

- 0 signifies temperature profile in this pressure regime valid (45% of retrievals over water; 20% of retrievals over land)
- 1 signifies temperature profile in this pressure regime, good enough for Level 3 but not for validation statistics (13% of retrievals over water; 47% of retrievals over land)
- 2 signifies temperature profile in this pressure regime invalid

### **Qual\_Surf**

Overall quality flag for surface fields including surface temperature, emissivity and reflectivity

- 0 or 1 occurs in 20% of all retrievals over water
- 1 occurs in 67% of all retrievals over land

### **Qual\_Cloud\_OLR**

Overall quality flag for cloud parameters and clear and cloudy outgoing longwave radiation. Retrieval of cloud parameters and OLR is attempted even in the event that the MW algorithm rejects the retrieval.

- 0 occurs when full combined MW/IR retrieval is performed (**retrieval\_type** = 0)
- 1 occurs when MW algorithm rejects the retrieval
- 2 rarely occurs

## **Cloud-Cleared Radiances Quality Checks**

### **Qual\_CC\_Rad**

The quality flag, **Qual\_CC\_Rad**, should be used as the main quality indicator in the Level 2 Cloud Cleared Radiance Product. The accuracy of the radiances in the cloud-cleared radiance product varies from channel to channel with the properties of the individual detectors. Some AIRS detector will have properties that will rule out their use for some purposes. Radiances are set to -9999 for detectors of lowest quality. Casual users can just check for -9999 as radiance values. The casual user will find this quality easiest to use.



## Version 4.0 L2 QA Quick Start Documentation

There is a set of dynamic flags and a set of static flags for each channel for cloud cleared radiance product. The static properties of each of the 2378 AIRS IR channels are summarized in a series of "**channel properties files**" keyed by effective start date.

Users of AIRS L2 Cloud-Cleared radiances will find it profitable to select channels whose entries in the appropriate channel properties file satisfy these criteria at a minimum:

<b>Criterion</b>	<b>column</b>	<b>required value</b>
AB_State	11	0, 1 or 2
Radiometric quality	12	0
L2_ignore*	13	0

**Table 3. Static Channel Property File**

\*L2\_Ignore includes additional information about SRF incompatibility with the AIRS transmission model. Users of this model or other similar models should avoid all channels where L2\_ignore is nonzero. Other users of L1B radiances may ignore this flag entirely.

The dynamic calibration flags, **CalFlag**, **CalScanSummary**, **CalChanSummary** and **ExcludedChans**, are copied to the cloud cleared radiance product files, as well as dynamic estimated noise **NeN**. Please refer to

**L1B\_QA\_Quick\_Start.pdf**

for a discussion and definition of the above flags.

## Quick Start QA for VIS/NIR L2 Data

### ***Per-Field-of-View Quality Checks***

The following QA flags are contained in the L2 Support Product, and should be checked for a value of 0 (zero), indicating that the relevant products are valid. Each of these QA flags is at AMSU resolution:

- **bad\_vis\_cld\_det** Set to 1 when a problem was encountered in the cloud detection algorithm
- **bad\_vis\_cld\_hgt** Set to 1 when a problem was encountered in the cloud height algorithm. Note, however, that no cloud height products have been validated, and the user is advised to ignore these fields regardless of the flag value

## ***Advanced Quality Checks***

The following QA flags are contained in the L2 Support product, and should be checked for a value of 0 (zero), indicating that the relevant products are valid. Each of these QA flags is at AMSU resolution:

- **vis\_glint** When set to 1, sun-glint may be affecting the reported Vis/NIR radiances and products